DIET OF THE FLIGHTLESS TROGID BEETLE *OMORGUS ROTUNDULUS* (HAAF) (COLEOPTERA: TROGIDAE) IN THE LITTLE SANDY DESERT OF WESTERN AUSTRALIA

TERRY F. HOUSTON[1], JINGYU ZHANG[2] and BRIAN P. HANICH[1]

[1]*Western Australian Museum, Locked Bag 49, Welshpool DC, WA 6986*
(Email: terry.houston@museum.wa.gov.au)

[2]*Formerly School of Environmental Biology, Curtin University of Technology, Perth, WA*

Abstract

A large collection of trogid beetles obtained from wet pit-traps in the Little Sandy Desert of Western Australia provided an opportunity to examine gut contents of a series of adult specimens of four species of *Omorgus* Erichson. The diet of the flightless species *Omorgus rotundulus* (Haaf) (by far the most numerous species trapped) proved to consist mainly of invertebrates, especially ants and termites. Guts of three alate species of *Omorgus*, by contrast, were largely devoid of solid material. Whether *O. rotundulus* is a predator of live invertebrates or scavenges dead specimens could not be established though the former is deemed to be more likely.

Introduction

Members of the worldwide beetle family Trogidae are commonly regarded as being either obligate or facultative necrophages. Most species are associated with vertebrate carrion, with adults and larvae feeding on the hair or feathers and dried skin and muscle, while other species have been found breeding in vertebrate burrows and nests, on the castings of predatory birds and in bat guano (Baker 1968, Lawrence and Britton 1994, Scholtz 1980, 1986a, Young 2006). Young and Hamm (1985) revealed a propensity for the American species '*Trox suberosus* Fabricius' (now *Omorgus suberosus*) to feed on dead insects, particularly armyworm caterpillars. Carrion-feeders depend on scattered and temporary resources for feeding and breeding. Presumably, adults of such species use their olfactory senses to seek out animal carcasses while on the wing. Some species, however, are flightless, having the elytra fused and the hind wings vestigial; this condition (accompanied by increased size) is common in desert beetles and probably helps to reduce water loss (Scholtz 1981). Aptery suggests a very different biology but, until now, no information has been available on the feeding and breeding habits of such species (C. Scholtz pers. comm.).

The trogid fauna of Australia consists of 53 known species of *Omorgus* Erichson (formerly included in *Trox* Fabricius) (Scholtz 1986a, b). Nine of them are flightless, having vestigial hind wings and fused elytra (Scholtz 1986a). The present paper makes available some information on the adult diet of one of these species, *O. rotundulus* (Haaf) (Fig. 1), which inhabits arid regions of northern Australia.

Materials and methods

This study was based on a collection of thousands of wet-preserved trogids donated to the Western Australian Museum by the collectors, Stephen van

Leeuwen and Bob Bromilow of the Western Australian Department of Environment and Conservation. The material was collected during 1995-1997 in the Little Sandy Desert, an area of Western Australia lying south-east of Newman, south-west of Lake Disappointment and north of Wiluna and taking in part of the Canning Stock Route. The beetles were collected by means of 30 permanently open pitfall traps (10 litre buckets) containing ethylene glycol and formaldehyde as a preservative. The traps were deployed in pairs at 15 trapping sites distributed across an area of varied soil and vegetation types between latitudes 23.88°-24.59°S and longitudes 120.26°-120.64°E. The pitfalls were installed and became operational between 18-27 October 1995 and were emptied in June and October 1996 and April and August 1997.

The bulk of the material (87%) consisted of *O. rotundulus* adults (body length usually 18-22 mm), while the remainder consisted about equally of the smaller, winged species *O. crotchi* (Harold) and *O. villosus* (Haaf), plus a few specimens of a winged species keying near *O. dilaticollis* (Macleay) in Scholtz's (1986a) key.

Sample specimens were dissected to remove the intestine from the abdomen and the intestine was then teased apart in water and its contents examined using both stereo and compound microscopes. Fragments of many insects were identified by comparison with specimens in the WA Museum collection.

Observations

Fifty specimens were selected at random from jars representing several of the survey sites in the Little Sandy Desert. Of these, 41 were *O. rotundulus* (7 males and 34 females) and the remaining nine represented the three winged species *O. crotchi, O. villosus* and *O. ?dilaticollis*. In these last three species, no recognizable food material was found in their intestines. By contrast, the intestines of most specimens of *O. rotundulus* contained at least some food. The bulk of the food material consisted of bits of insects and other invertebrates or at least fragments of chitin. Occasionally, fragments of vegetative material and sand grains were also found. Chitinous material was observed in 38 (93%) of the *O. rotundulus* specimens and the quantity varied considerably. At one extreme, just a few bits of chitin were present and, at the other, the gut was packed solidly from end to end, stretching apart the abdominal tergites and sternites.

Ants and termites were the most commonly recognised invertebrates in gut contents of *O. rotundulus* and all parts of these insects were found, including the wings of termite alates. Various kinds of ants could be distinguished (included were species of *Iridomyrmex* Mayr, *Melophorus* Lubbock, *Pheidole* Westwood and *Tetramorium* Mayr) and the termites included soldiers (nasute type), workers and alates. A variety of other invertebrates

were identified also, including Hemiptera (Cydnidae), Coleoptera and Arachnida (unidentified spider or mite with plumose setae on the legs).

Fig. 1. *Omorgus rotundulus* (Haaf) from the Little Sandy Desert of Western Australia. In this flightless species, the elytra are fused into a 'carapace'. (Scale bar = 5 mm).

Minor amounts of plant tissue were noted in just a few cases and included thick-walled plant hairs, vascular tissue and other unidentified tissue. Along with it were copious amounts of partly digested soft animal tissue and numerous pieces of thin chitinous membrane that was colourless, spiculate and setose. The latter was tentatively identified as moth larva integument.

There were no discernible differences in gut contents between the sexes. In cases where the gut was especially full, it was noted that the fat body was well developed, forming a solid layer enveloping the internal organs.

Examples of *O. rotundulus* were found in each of the four sampling periods but numbers varied significantly. The 30 pitfall traps yielded combined totals of 2 and 32 beetles for the June and October 1996 samples, respectively. By contrast, just nine of the traps yielded combined totals of 1261 and 219 beetles for the April and August 1997 samples, respectively. (Counts are not available for the remaining 21 pitfalls). Individual counts for these same nine pitfalls in April varied from 1-250 beetles and six pitfalls yielded 180 or more. The highest individual count in the August 1997 sample was 188.

Notes accompanying the collections provide some insights into the habitats where *O. rotundulus* occurred. The greatest numbers of specimens were from sites having deep sandy soils (dune crests and slopes and swales between dunes having deep consolidated red sand). Lesser but still substantial numbers were also trapped at sites with harder soils (red clay loam with calcrete; skeletal red-brown gritty soil over massive sandstone; stony gibber with gritty clay-loam; skeletal soil over buckshot laterite and lateritic duricrust). The vegetation at *O. rotundulus* sites varied accordingly, including 'heath', shrubland (including chenopod association) and open woodland. Spinifex (*Triodia* sp.) was the dominant grass at most sites.

Discussion

The observations presented above reveal that *O. rotundulus* adults consume a wide variety of soil-dwelling arthropods but their greatest predilection is for ants and termites. The presence of plant tissue among the gut contents of a few specimens might indicate that *O. rotundulus* is omnivorous, but the presence of caterpillar-type tissues along with the plant tissue provides an alternative explanation: the plant material could be derived from the intestine of a caterpillar prey item.

The large numbers of specimens of *O. rotundulus* captured in the pitfall traps, particularly those in deep sandy soil areas, indicate that dense populations were present during the trapping period. The fact that ants and termites form the bulk of the beetles' diet helps to explain how such numbers could occur. There could be no more numerous insects in the Little Sandy Desert than ants and termites. A question our study has not been able to answer is – do the beetles capture and eat live prey or do they scavenge dead specimens?

Adults of *O. rotundulus* are slow moving, possess short, blunt mandibles and do not have the appearance of predacious beetles. If they eat live prey, perhaps the beetles feed where the prey are concentrated and their movement restricted, for example at ant nest entrances, termite foraging gallery exit holes or along foraging trails. Scavenging would be more in line with the known habits of Trogidae, although Scholtz (1986a) noted African and/or American species feeding on living locust eggs and fly maggots. If *O. rotundulus* eats dead insects, it is difficult to explain where the beetles would find such large quantities as was observed in the intestines of some individuals. Direct observation of the beetles' feeding habits will be required to resolve these questions.

Flightless *Omorgus* specimens have been collected while wandering on the ground surface (C. Scholtz pers. comm.) and *O. mariae* Scholtz adults were excavated by the senior author from burrows up to 20 cm deep in yellow sand (July 2007 at Eurardy Reserve bordering Kalbarri National Park). The burrow entrances were covered by loose, lumpy tumuli. Other than that, nothing else has been recorded of the behaviour of the flightless species.

Given the adult diet, it will be interesting to discover on what and where the larvae feed. Perhaps they will be found in the nests of ants and termites, for it would require an abundant food source to sustain the high populations observed.

A few further conclusions may be drawn from the large Little Sandy Desert collection of *O. rotundulus*:

a) Ethylene glycol and/or formaldehyde must be attractive to the beetles; otherwise it is difficult to explain why so many specimens fell into the pitfall traps. Some experiments to test this are warranted.

b) The species can be encountered throughout the year. The very large numbers encountered in April and August 1997 samples can probably be attributed to particularly good rainfall in the study area during the summer of 1996-1997.

c) Evidently, the species is not narrowly habitat specific, given the range of soil and vegetation types recorded at collection sites.

Acknowledgements

We are most grateful to Stephen van Leeuwen and Bob Bromilow of the Western Australian Department of Environment and Conservation for providing their pitfall collections to the WA Museum and for the provision of associated data. We thank Prof. Clarke Scholtz (South Africa) and Prof. Henry Howden (Canada) for sharing their knowledge of Trogidae with us during the course of this study and for critically reading an early draft of this paper.

References

BAKER, C.W. 1968. Larval taxonomy of the Troginae in North America with notes on biologies and life histories (Coleoptera: Scarabaeidae). *United States National Museum Bulletin* **279**: 1-79.

LAWRENCE, J.F. and BRITTON, E.B. 1994. *Australian Beetles*. Melbourne University Press, Carlton, Victoria; 192 pp.

SCHOLTZ, C.H. 1980. Monograph of the genus *Trox* of subsaharan Africa. *Cimbebasia Memoir* **4**: 1-104.

SCHOLTZ, C.H.1981. Aptery in *Trox* (Coleoptera: Trogidae): morphological changes and their relationship to habitat. *Journal of the Entomological Society of Southern Africa* **44**: 83-87.

SCHOLTZ, C.H. 1986a. Revision of the genus *Trox* Fabricius (Coleoptera: Trogidae) of the Australasian Region. *Australian Journal of Zoology Supplementary Series* **125**: 1-29.

SCHOLTZ, C.H. 1986b. Phylogeny and systematics of the Trogidae (Coleoptera: Scarabaeoidea). *Systematic Entomology* **11**: 355-363.

YOUNG, O.P. 2006. Survival and reproduction of *Trox suberosus* F. (Coleoptera: Trogidae) on insect cadavers, cow dung, and mushroom. *Journal of Entomological Science* **41**: 271-276.

YOUNG, O.P and HAMM, J.J. 1985. The effect of the consumption of NPV-infected dead fall armyworm larvae on the longevity of two species of scavenger beetles. *Journal of Entomological Science* **20**: 90-94.